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ABSTRACT

This study tested the hypothesis that the frequency of prosocial behavior of six 5-year-old kindergarten boys could be increased by reinforcing such behavior more powerfully than competing, non-social behavior. A sand-play machine was designed for the study. The machine could be modified to structure contingencies of reinforcement for social behaviors in three ways. In the baseline condition prosocial and non-social behaviors were reinforced equally. In the second, or "hard-contingency" condition, interaction with the machine was only possible if prosocial behavior occurred; therefore, only prosocial behavior was reinforced. In the third, or "soft-contingency" condition, both non-social and prosocial behaviors were reinforced, but reinforcement of prosocial behavior was delivered more powerfully. Players were randomly assigned to dyads which remained the same throughout the study. The experiment was conducted in 24 sessions distributed over six weeks. All sessions were videotaped and subsequently blind coded. The following dependent variables were measured: (1) filling sand into one's own part of the machine; (2) filling sand into the partner's part of the machine; (3) cranking the machine; (4) requesting a fill from the partner; and (5) contracting for mutual fills. Behavior frequencies were recorded for dyad totals, rather than for individuals. Results confirmed the original hypothesis and also indicated that changes in those physical features of the play environment that alter the structure of social contingencies between players produce measurable effects on social behavior. (Author/RH)

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Social Contingencies in the Physical Environments and Prosocial Behaviour in Children's Play

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Social Contingencies in the Physical Environments

and Prosocial Behavior in Children's Play

The purpose of this study was to test two hypotheses. The first hypothesis was that changes in physical features of a play environment that altered the structure of social contingencies between players would produce measurable effects on social behaviour. One rationale for this hypothesis was that social behaviour is learned in the same way that any other behaviour is learned. The positive results of contingent reinforcement strategies have been well documented in regard to the development of prosocial behaviour in young children (e.g., Ullman and Krasner, 1965). Another rationale for the first hypothesis is that the interaction between a player and a play environment, including playthings and other players, can be managed by a physical plaything so that the feedback from the environment exerts at least partial control over the behaviours occurring in the player-player interaction.

Gehlbach (1980) proposes a paradigm for the representation of play which emphasizes the feedback system in the interaction of a player and a play stimulus. His paradigm, shown in Figure 1, includes player, environmental and playthings factors. For example, presented with a pile of blocks, a child's initial behaviour will depend in part on factors such as age,

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Insert Figure 1 about here

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cognitive level and history of reinforcement, and in part on the environmental factors which include both physical and social aspects. Similarly, the

behaviour of the blocks depends on the action of the child, and on environmental parameters such as the surface on which they rest, and the presence or absence of other children. The behaviour of the blocks also depends on the properties of the blocks themselves. The response of the blocks, in turn, affects the subsequent behaviour of the child. If the block response is reinforcing to the child, the child's actions are likely to recur. The third rationale is that even without adult intervention, behaviour can be modified effectively if the design of the plaything provides consistent contingencies of reinforcement for that behaviour. If, in the physical structure of the play environment, a contingency network is provided such that the feedback from the play object predictably reinforces a specific target behaviour, play might become a vehicle for instruction, rather than simply an interesting phenonmenon.

If play is to be instructional, there are three requirements: 1) since play by definition is "voluntary," a play environment, or stimulus set, must be provided which reliably prompts target behaviours as operants; 2) the operative contingency must be determined solely by the character or structure of the plaything or play environment, which governs the overall environmental response to successive player behaviours requiring no instructional intervention by adults; and 3) the interaction must result in predictable occurrence of a specifiable change in behaviour.

The educational problem with existing playthings and play environments is that there has been virtually no empirical evidence indicating that the results of interaction with them is more than incidentally educational, let alone specifically instructional (Derman, 1974; Gehlbach, 1975). The emphasis has been on stimulus properties with either physical dimensions such as colour or height, or with dimensions such as novelty, or frequency of previous

encounters (e.g., Ellis & Scholtz, 1978; Farnham, Diggory & Ramsey, 1971; Harper & Sanders, 1975; Lewis, 1972). Relatively few playthings or environments are designed with attention to the results of usage, and of those, even fewer have been empirically tested (e.g., Derman, 1974; Kamii & DeVries, 1978).

A notable pioneer in the design of playthings for specific goals was Maria Montessori (1973). While Montessori used the term "activity" rather than play, the materials she designed fulfill the requirements of instructional play materials in that the usage is voluntary, but the player's behaviour is deliberately manipulated through the physical structure of the materials, to sustain activity and produce specific outcomes.

Studer (1973) advocates the application of the methods of the behavioural sciences to the problem in environmental design and evaluation. He suggests that "The task is . . . to arrange environmental contingencies such that particular stimuli and behaviour become functionally linked through discriminative learning. The environmental-behaviour relationship is thus designed and implemented" (p. 142). The second hypothesis was that behaviour can be modified effectively with respect to a target behaviour, even when a competing non-target behaviour is reinforced. One of the basic conventions in both basic and applied research in behavioural psychology is that continuous reinforcement schedules are utilized in early attempts to systematically modify behaviour (Ferster & Skinner, 1957). Gehlbach (note 1) refers to continuous reinforcement networks as "hard-contingency networks," since reinforcers are delivered if, and only if, the target behaviour is performed. Such a schedule rarely occurs in natural learning environments. In natural settings, it is

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often the case that both target and non-target behaviours are reinforced. Nevertheless, the target behaviour ultimately and predominantly occurs. For example, a child may open containers and be reinforced by immediate acquisition of the contents. However, the child might also acquire the contents as a result of crying for help. Both behaviours may be reinforced, yet the child ultimately tends to open containers without being aided by others.

Behavioural theory does not adequately explain this latter phenomenon. In the container-opening example, reinforcement does not occur if, and only if the child opens the container, therefore the dependency is not a hard-contingency network. Nevertheless, container opening emerges as the predominant behaviour. On the other hand, when reinforcement is not contingent on the occurrence of a target behaviour -- that is, when both target and non-target behaviours are reinforced, one would infer from behavioural theory that learning of the one behaviour is as likely as learning of the other behaviour. In the previous example, therefore, there should be no predictability of container-opening behaviour on the part of the child. Gehlbach (note 1) suggests a third contingency network which might explain learning that occurs when (a) both target and incompatible behaviours are reinforced, but (b) the target behaviour emerges as dominant. He labels it a "soft-contingency network." The hypothesis of a soft-contingency network is a departure from classical behavioural theory. Behavioural theory attends only to the occurrence or non-occurrence of reinforcement in relation to the target behaviour and other behaviours. In a soft-contingency network, according to Gehlbach, it is the level or strength of the reinforcement which is differentiated in the environment and hence is responsible for the

emergence of a dominant response. As in the case of container opening previously described, some degree of the same form of reinforcement (i.e., acquisition of contents) might occur for both target and non-target behaviours, but the reinforcement for the target behaviour must in some way be more powerful for container-opening behaviour, if unassisted container opening usually emerges as the predictable response.

The present study tested the hypothesis that the frequency of social behaviour could be increased simply by reinforcing it more powerfully than competing, non-social behaviours. A plaything was designed to deliver reinforcement on three different contingency levels, by means of small changes in one detail of the physical structure. At the baseline level, both prosocial and non-social behaviours were reinforced in a manner comparable to free play in an open sandbox. Prosocial behaviour was operationally defined to include the following behaviours: 1) filling sand into the partner's side of the apparatus; 2) verbal requests for sand; and 3) contracts in regard to giving and receiving sand. Non-social behaviours included: 1) filling sand into the player's own side; and 2) cranking the machine. When the plaything was adjusted for a hard-contingency network, only prosocial behaviour (the target) was reinforced. In the soft-contingency condition, both non-social and prosocial behaviours were reinforced, but they were reinforced differently. Social behaviour was recorded and analyzed for each of the three conditions.

Method

Subjects. Six five-year old boys from a kindergarten in Burnaby, British Columbia participated in the study. There were three reasons for the choice of five-year old boys as subjects: 1) prosocial development is a common target

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behaviour in kindergartens; 2) the use of only boys eliminated a possible sex variable, and 3) there is some indication that five-year old boys, when playing with a same-age peer, are less prosocial than children in other preschool age-sex combinations (Lewis, 1972). Thus, the possibility of a ceiling effect was reduced.

Materials

A sand-play machine was especially designed for the study (see Figure 2).

Insert Figure 2 about here

It was comprised of two identical sides, separated by an upright divider. Each side contained a vertical chute which directed sand to an enclosed horizontal conveyer belt, activated by a hand crank. Sand dropped through holes in the bottom of the horizontal enclosure, providing the opportunity to create sand "mountains" or to fill a container or truck appropriately placed by a player. The machine could be modified to structure the contingencies of reinforcement for social behaviours in three different ways. In the baseline condition prosocial and nonsocial behaviours were reinforced equally. That is, mountains could be created, or trucks filled with equal ease and success by either type of behaviour. In the second, or "hard-contingency" condition, interaction with the machine was only possible if prosocial behaviour occurred, therefore only prosocial behaviour was reinforced. In the third, or "soft-contingency" condition, both nonsocial and prosocial behaviours were reinforced, but reinforcement of prosocial behaviour was delivered more powerfully.

Procedures

A single-case analysis-of-variance design with two replications was employed, with conditions randomly assigned over time (Hersen & Barlow,

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1976). Players were randomly assigned to dyads which remained the same throughout the study. The experiment was conducted in 24 sessions, over six weeks. Conditions were randomly distributed in two blocks of 12 sessions each over three week units of time. All sessions were videotaped, and subsequently blind coded. The following dependent variables were measured: 1) filling sand into one's own part of the machine; 2) filling sand into the partner's part of the machine; 3) cranking the machine; 4) requesting a fill from a partner; and 5) verbal contracting for mutual fills. Behaviour frequencies were recorded by dyad totals, rather than for individuals. Halfway through the experiment, interest in the sand machine appeared to be lagging. Consequently, a minor change was made to increase appeal without changing the structure of interaction. A plexiglass panel was inserted in the front surface of the horizontal enclosures, making the chain conveyors visible.

Results and Discussion

The coefficient of intercoder reliability was .91. Results indicated that changes in those physical features of the play environment that alter the structure of social contingencies between players produce measurable effects on social behaviour. Totals for the two major non-verbal social behaviours (fill to self and fill to partner) are displayed in Figure 3. Means and standard deviations by cell are reported in Table 1.

Insert Table 3 about here

In this study, the physical structure of the plaything acted as the agent, so to speak, which managed the reinforcement contingencies for operant behaviour of the players. The only physical change in the environment

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was an alteration in the relative access to filling apertures.

Because the sand machine was altered at the midpoint of the sessions, differences between the first and second parts of the study were examined. There was a statistically reliable difference ($p < .05$) between the first and second parts of the study only on the cranking variable. An examination of the raw data revealed that 40% of the cranking behaviour occurred in the first three of the 24 sessions, indicating that the difference in cranking behaviour in the two parts was probably due to a novelty effect at the onset of the experiment, rather than to the modification of the machine itself.

Treatment was the major independent variable around which the experiment was designed. An analysis of variance indicated a significant treatment effect on the major variables Fills to Self [$F_{(2,71)} = 12.85$, $p = .000$], and Fills to Partner [$F_{(2,71)} = 6.71$, $p = .002$]. There was also a significant treatment effect on Requests [$F_{(2,71)} = 4.60$, $p = .014$], but the effect of treatment on Contracts was not statistically reliable.

Results of the study also confirmed the hypothesis that a soft-contingency network would produce the target behaviour at a level above the baseline, or no-contingency, network. A post-hoc Newman-Keuls test indicated that although there was not a statistically reliable difference ($p > .05$) between the hard and soft-contingencies, there was, overall, a reliable difference ($p < .05$) between both contingency treatments and the baseline condition.

One question arising from this study is whether instructional playthings should be designed to incorporate a hard- or soft-contingency network. The results of this study indicate that a soft-contingency network reinforcement is at least as effective as a hard-contingency one. With a hard-contingency

network in operation, the plaything is instructional only to the degree that the child interacts with it. If the child is relatively unskilled, that interaction may not occur, since the child is effectively penalized by no reinforcement. With non-target behaviours reinforced at least to some degree, the unskilled child may interact with the plaything more frequently than he would otherwise. If the frequency of occurrence of target behaviour is equal for hard- and soft-contingencies, and if it were found that interaction time were increased with a soft-contingency network, one may assume that, over time, the <u>total</u> frequency of the target behaviour in a play setting would be greater with a soft-contingency reinforcement than with a hard-contingency reinforcement.

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Table 1

Means and Standard Deviations By Cell

Variable	Dyad	Treatment			
		NC	HC	SC	Total
Fills to Self	A	26.38 (18.15)	0.75 (2.12)	5.63 (9.52)	10.92 (16.06)
	B	17.87 (17.07)	3.13 (6.27)	3.15 (3.69)	8.08 (12.44)
	C	4.13 (4.39)	1.25 (2.43)	8.50 (11.74)	4.63 (7.67)
	Total	16.13 (16.80)	1.70 (4.03)	5.79 (8.86)	7.88 (12.63)
Fills to Partner	A	1.25 (1.67)	12.50 (11.51)	11.13 (8.54)	8.29 (9.57)
	B	4.38 (6.26)	10.38 (9.09)	6.75 (5.97)	7.17 (7.36)
	C	0.13 (0.35)	3.50 (3.81)	1.00 (2.07)	1.54 (2.81)
	Total	1.92 (4.02)	8.79 (9.23)	6.29 (7.23)	5.67 (7.62)

Note: Upper figure is mean. Lower figure is standard deviation

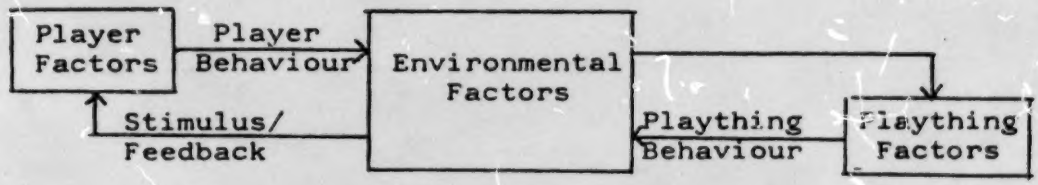
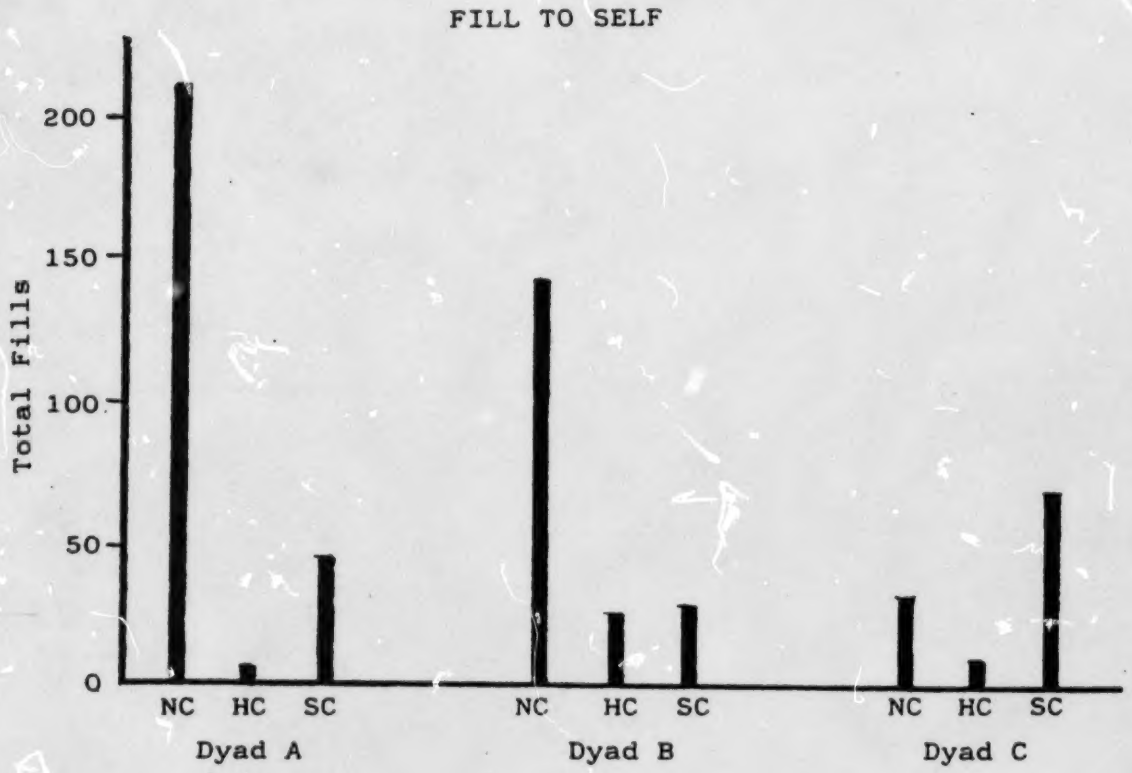


Figure 1. A cybernetic diagram representing a simple play event, with a single player, a set of playthings, and a player/plaything environment. Boxes represent sets of relatively stable control variables, and arrows represent change. (Courtesy of Roger D. Gehlbach)

FIGURE 2



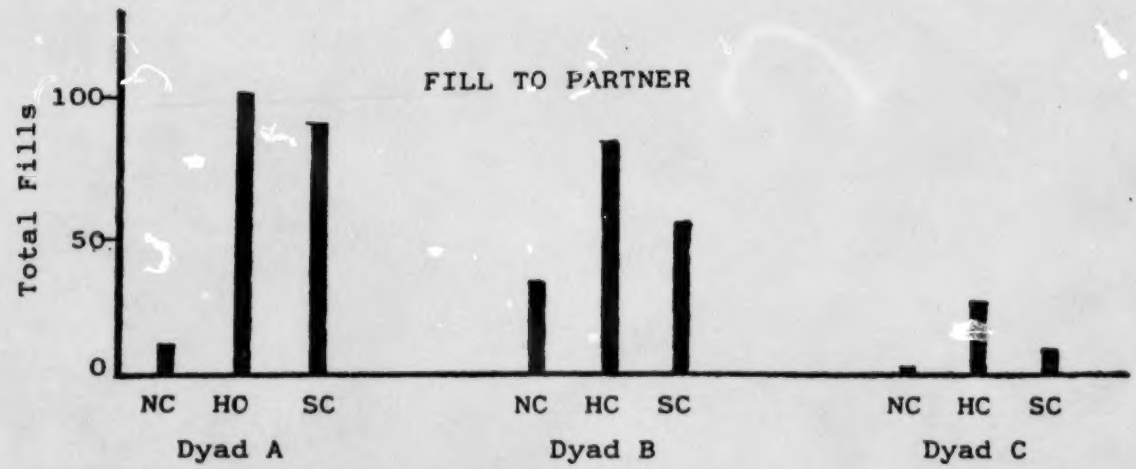


Figure 3. Totals for the two major social variables, for each dyad.